XP009037355

Conclusions: Despite increased depth of MVP, MR decreases with DSE as the LV and MA become smaller, increasing the leaflet available for effective coaptation.

3:15 p.m.

812-6 Differential Left Ventricular Remodeling in Volume Overload: A Quantitative Echocardiographic Study

Roland R. Brandt, Maurice E. Sarano, James B. Seward. *Mayo Clinic and Foundation, Rochester, MN, USA*

Background: Left ventricular (LV) dilatation is a complication of LV volume overload and the precursor for LV dysfunction. However, it is unclear whether different types of LV volume overload induce distinct patterns of LV remodeling.

Methods: Three geometric variables of LV remodeling: systolic and diastolic length-to-diameter (L/D) ratio as an index for global LV cavity shape and mitral-to-aortic annular area (MAA/AAA) ratio as a measure for LV shape at the base of the heart and three different variables for LV volume overload: enddiastolic volume, total stroke volume, and regurgitant fraction were measured prospectively by echocardiography in three groups of patients (pts): 28 normal pts (N), 138 pts with organic mitral regurgitation (MR), and 56 pts with aortic regurgitation (AR).

Results: Systolic and diastolic L/D ratios were both lower in MR and AR compared to N (all: $p < 0.001$) demonstrating increased LV sphericity in valvular regurgitation. Adjusted for the degree of volume overload, LV cavity was more spherical in MR than AR both in systole and diastole (all: $p < 0.001$). MAA/AAA ratio was higher in MR ($p < 0.001$) and lower in AR ($p < 0.01$) compared to N. With increasing volume overload, MAA/AAA ratio increased in MR but decreased in AR ($p < 0.001$ by covariance analysis).

Conclusion: 1. LV volume overload due to valvular regurgitation is associated with LV remodeling. 2. LV cavity is more spherical in MR than AR despite a similar degree of volume overload. 3. There is differential remodeling at the base of the heart with increasing volume overload in MR and AR. 4. Different types of LV volume overload induce distinct patterns of LV remodeling which may have important clinical implications for LV function.

NONINVASIVE IMAGING

ORAL

815 Novel Tissue Doppler Approaches for Evaluating Ventricular Function

Monday, March 8, 1999, 2:00 p.m.–3:30 p.m.
Morial Convention Center, Room 222

2:00 p.m.

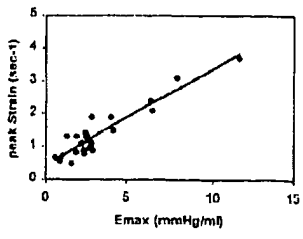
815-1 Abnormal Doppler Derived Myocardial Systolic Strain Rate Is a Strong Index of LV Contractility

Mario J. Garcia, Neil L. Greenberg, Michael L. Main, Peter Castro, Michael S. Firstenberg, Agnes Travaglini, Leonardo Rodriguez, James D. Thomas. *Cleveland Clinic Foundation, Cleveland OH, USA*

Background: Myocardial fiber strain is directly related to LV contractility. Strain rate can be estimated as the spatial derivative of velocities (dv/dt) obtained by tissue Doppler echocardiography (TDE).

Methods: TDE color M-mode images of the interventricular septum were recorded from the apical 4-chamber view in 4 closed-chest anesthetized mongrel dogs during 4–5 different inotropic stages. Simultaneous LV volume and pressure were obtained with a combined conductance-high fidelity pressure catheter. Peak elastance (Emax) was determined as the slope of end-systolic pressure-volume relationships during caval occlusion and used as the gold standard of LV contractility. Peak systolic TDE myocardial velocities (Sm) obtained at the basal septum, peak (ε_p) and mean (ε_m) were compared against Emax by linear regression.

Results: Emax as well as TDE systolic indices increased during inotropic stimulation with dobutamine and decreased with the infusion of esmolol. A stronger association was found between Emax and ε_p ($r = 0.94$, $p < 0.01$, $y = 0.29x + 0.46$) and ε_m ($r = 0.88$, $p < 0.01$) than for Sm ($r = 0.75$, $p < 0.01$).



Conclusions: TDE derived ε_p and ε_m are strong noninvasive indices of LV contractility. These indices appear to be more reliable than Sm, perhaps by eliminating translational artifact.

2:15 p.m.

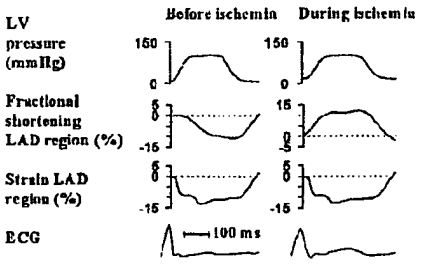
815-2 Myocardial Strain Rate Imaging: Validation of a New Doppler Method to Quantify Regional Myocardial Function

S. Urheim, H. Torp[1], T. Edvardsen, B. Olstad[1], S.I. Rabben[1], A. Heimdal[1], B. Angelsen[1], O.A. Smiseth. *Inst. for Surgical Research, The National Hospital, Oslo; [1]NTNU, Trondheim, Norway*

Background: We investigated whether myocardial strain can be derived with Doppler tissue velocity techniques. Sonomicrometry was used as reference method.

Methods: In 8 anesthetized dogs myocardial ultrasonic crystals were placed longitudinally in the LAD and the Cx regions and micromanometer in the LV. Measurements were done before and during LAD occlusion. Strain rate was calculated in real-time on apical images as differences in tissue velocity per unit length (1/sec). By integrating strain rate over time, we obtained strain throughout the cardiac cycle. The strain estimates express percentage variations in longitudinal shortening.

Results: Doppler derived strain correlated with dimensional changes; mean $r = 0.75$, $p < 0.05$ (range 0.60–0.86) in nonischemic and $r = 0.76$, $p < 0.05$ (range 0.46–0.95) in ischemic regions in systole. Before ischemia percentage systolic strain was -16 ± 1 ($\pm$ SEM) by sonomicrometry and -12 ± 1 (%) (ns), by the Doppler method, and during ischemia 13 ± 2 and 11 ± 2 (%) (ns), respectively. See figure.



Conclusion: In conclusion, strain rate imaging reflects regional myocardial dimensions and may represent a new powerful tool for quantifying left ventricular function.

2:30 p.m.

815-3 Strain Rate Imaging: New Assessment of Myocardial Diastolic Stiffness Associated With Acute Ischemia

Marek Belohlavek, Richard Y. Bae, Andreas Helmdal[1], Bjorn Olstad[1], James F. Greenleaf, James B. Seward. *Mayo Clinic, Rochester, MN, USA; [1]The Norwegian University of Science and Technology, Trondheim, Norway*

Background: Myocardial isovolumic relaxation (IR) is an energy-dependent process which is delayed during acute ischemia (AI). We hypothesized that the duration of regional systolic compression will be prolonged in AI and this prolongation will be measurable by a new real-time strain rate imaging (SRI) echocardiography which is based on spatial derivative of local myocardial velocities.

Methods: Apical long-axis SRI was performed in 6 open-chest pigs at baseline and immediately after LAD coronary artery ligature using the Vingmed System Five. Each view was subdivided into 6 anatomic regions: inferior basal, mid, apical; and anterior basal, mid, and apical. Mean duration of systolic compression was obtained for each segment and the global (data pooled from all segments) and regional differences before and after coronary artery ligature compared.

Results: The global LV isovolumic relaxation onset was significantly delayed by 47.0 17.1 ms ($p < 0.05$) due to the prolonged systolic compression. Regional analysis of the corresponding segments before and after the coronary ligature revealed that systolic compression caused a statistically significant IR delay only in the impaired anteroapical segment (67.2 56.1 ms, $p < 0.05$). In the remaining segments the average IR delay ranged from 20 to 63 ms.

Conclusions: A new real-time assessment of myocardial stiffness (i.e., strain rate imaging) was studied. Local and global quantifiable distributions of altered myocardial strain rate appear to be a useful indicator of myocardial injury.